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ABSTRACT

The influence of theory on instructional-design models of the future is explored on the basis of the theoretical developments of today. Anticipated model changes are expected to result from disparate theoretical thinking in areas such as chaos theory, constructivism, situated learning, cognitive-learning theory, and general systems theory. Instructional-system design models (ISD) are likely to continue to be a driving force among practitioners for the next decade. The typical pattern of use for such models is linear, but support for nonlinear models is appearing. The constructivist influence is permeating much thinking on instructional design and will surely be part of the newer, expanded needs-assessment orientation. Design models of the future are likely to incorporate more formative and summative evaluation. These enhancements of the typical macrodesign model will be complemented by changes in micromodels that guide the selection and sequencing of instructional strategies. Two key issues will be the nature of learner control in design models of the future and in the transfer of training strategies. The diversity of approaches in the future offers new challenges for practitioners and researchers alike. (Contains 27 references.) (SLD)

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Title:

Design 2000: Theory-Based Design Models of the Future

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Instructional design was born in the twentieth century, emerging from the theoretical roots of other disciplines. The foundations of macro-design processes are in general systems theory and are apparent in the instructional systems design (ISD) models, as exemplified by the Dick and Carey (1990) model. The micro-design strategies are based primarily upon learning and instructional theory as exemplified by Gagne's Events of Instruction. Designers use both macro- and micro-models[1] to provide direction for their work and, as Duffy and Jonassen (1991) have noted, design endeavors are always theory-dependent even though the designers may not be explicitly aware of the application. The task of this paper is not to describe theory changes in the field, but rather to anticipate the nature of the influence theory will have upon the design models of the twenty-first century, based upon the emerging theoretical developments of today.

Efforts will be made to distinguish between model enhancements which are generated primarily from new theory and research, as opposed to model enhancements which are the product of changing practitioner traditions, such as those prompted by emerging constraints in the workplace, or the impact of the new technologies. Admittedly, this demarcation is not always clear since practice and theory are often interrelated, and ISD models themselves are typically a result of the combination of abstract theoretical principles and analyses of practitioner experience. At times, this blurring of theoretical and practical innovations is evidenced by emerging models which seems to represent the impact of new *thinking*, rather than actual theory.

The anticipated model changes discussed in this paper are the result of the disparate theoretical thinking in areas such as chaos theory, constructivism, situated learning, cognitive learning theory and general systems theory. In addition, examples of new ideas which bridge theory and practice will also be addressed. Such topics include designer decision making research, performance technology, and the quality movement.

ISD Models of the Year 2000

In spite of the criticism in some quarters of traditional ISD models (see Richey, 1993 for a review of such criticism), it is difficult to imagine that they will not continue to be a driving force among practitioners in the next decade. It is likely, however, that they will change. These trends appear to be directed generally toward altering the traditional linearity of the design process, and specifically toward the expansion of front-end analyses, and the formative and summative evaluation procedures. The fact that these aspects of the design process are topics of discussion is not unusual; the nature of the discussion is unusual, because of the current efforts to reduce design cycle time to accommodate time and money constraints (Dick, 1993a; Gustafson, 1993). Needs assessment and evaluation procedures are typically the first design elements to be sacrificed by practitioners, and the linear structure facilitates the use of rapid prototyping and other techniques used to reduce cycle time. Nonetheless, these are the areas impacted most by current theoretical trends.

Nonlinear Design Models of the Future. While most current ISD models are not explicitly constructed for use only in a linear fashion, it is nonetheless the typical pattern of use. Criticism of this practice is becoming more widespread, and it is sustained by the

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[1]In some parts of the literature the terms "macro-design" and "micro-design" refer to the size of the instructional unit, with macro referring to program or curriculum design and micro referring to lessons or modules. This is *not* the orientation here; rather I am distinguishing between overall design and development processes, and strategy selection and sequencing.

growing interest in chaos theory, cognitive advancements, and a new look at general systems theory. Quite briefly, chaos theory posits the existence of order within apparently chaotic or seemingly random systems (You, 1993). Chaos theory, especially when examined in detail, can have great implications for instructional design. You (1993) discusses the notion of linearity within the ISD process and the support chaos theory gives to changing from linear to nonlinear design models. He asserts that *non*linear ISD models:

> assume a more holistic orientation, rather than one of mutual causality;
> are able to better accommodate those factors in a given situation which can interfere with the prescribed design processes; and
> reflect the dynamic and unpredictable aspects of the learning process.

Due to this nonlinear process, the while (i.e. the final instructional product) becomes more than the sum of its parts. This position stems from a view of current linear models as reductionist in nature, implying a cause and effect relationship between the various stages in the ISD process. In other words, the output of one phase becomes the input of the next.

Support for nonlinear design models also is appearing from traditional sources of design theory -- from cognitive psychology and general systems theory. Tennyson (in press) sees emerging design models (ISD^4, or fourth generation instructional design) as a reflection of the cognitive science movement. Specifically, this new form of ISD is "a dynamic, problem solving approach...controlled by contextual or situational problem solving evaluations" (p. 10). This new ISD is a flexible, dynamic process with its various component activities "connected by context rather than by predefined ID processes" (p. 11). The activity domains (analysis, design, production, implementation, and maintenance) are based upon a situational evaluation. The domains are viewed as overlapping activities, activities which can be continually adjusted as new conditions arise.

The notion of instructional design as an activity with many component processes which are completed in an iterative, overlapping, or even concurrent fashion is not inconsistent with the original presentations of general systems theory. Systems were viewed as existing within and interacting with an environment. Systems were viewed as a whole. Systems were viewed as dynamic. Currently, these attributes are being reexamined in terms of *systemic* design, as opposed to *systematic* design. The use of the word "systematic" implies using specified design procedures, while the word "systemic" implies concurrent consideration of the many aspects of a situation which can affect the learning process (Richey, 1992). There is more emphasis on design as creative problem solving (Romiszowski, 1981), flexibility, and adaptability in systemic design. Not only does the systemic approach imply the consideration of a wider range of variables in the design process, it also implies the use of a nonlinear orientation. It prevents the use of piecemeal solutions to education and training problems.

The Role of Analysis in Design Models of the Future. The role and importance of instructional context has been expanding, bolstered not only by the theoretical emphasis on environment in systems theory, but also by the current impact of constructivism, cognitive psychology, and performance technology. While such theory also is influencing the development of particular analysis techniques (such as cognitive task analysis), the emphasis here is upon anticipated changes in the ISD models themselves, especially with respect to the various forms of front-end analysis.

Seels (1989) indicates that the "constructivist paradigm states that learning occurs because personal knowledge is constructed by an active and self-regulated learner who resolves conflicts between ideas and reflects on theoretical explanations" (p. 13). Constructivism further holds that meaning is based upon experience and the context in which that experience takes place (Duffy and Jonassen, 1991). The constructivist influence is permeating much thinking on instructional design, and is part of the growing emphasis on

the importance of learner characteristics in the design task. Rather than concentrating primarily upon the learner's prerequisite skills, learner's experiential background, attitudes, and interests are also being addressed. Such considerations become one feature of the newer, expanded needs assessment orientation.

In addition to this broader consideration of learner characteristics, new pre-design analysis procedures are also breaking away from the old almost total emphasis on subject matter by addressing the nature of the environment as well. For example, Tessmer and Harris (1992) proposed an analysis which addressed the learning environment and the support environment. Richey (1992) has demonstrated the critical role of not only a variety of learner characteristics, but the learner's perceptions of the organizational climate in training design. Richey and Tessmer (in press) have now merged these two approaches in a comprehensive model of contextual analysis which includes consideration of three temporal environments in the front-end analyses: pre-instructional, instructional, and post-instructional. Each environment is analyzed to determine the essential physical and psycho-social factors from the immediate and surrounding environment that influence learning and transfer of training.

Contextual analysis is also prompted by the increasingly wide-spread influence of performance technology. Here, the orientation is toward solving organizational performance problems, with education and training seen as only one possible solution. The characteristics of the environment are critical during the front-end analysis which is viewed more of a problem analysis directed toward the larger organizational setting, as opposed to a needs assessment directed primarily toward learner knowledge and skill deficiencies.

The Role of Evaluation in the Design Models of the Future. Interestingly, most current ISD models do not include a comprehensive notion of evaluation. The majority of models reviewed by Andrews and Goodson (1991) addressed only formative evaluation of products and programs and needs assessment, but did not specifically include a summative evaluation phase. Notable exceptions are the design models of Dick and Carey (1990) and Seels and Glasgow (1990). It is anticipated that not only will the models of the twenty-first century address both formative and summative evaluation, but that the nature of such evaluation will be expanded from what typically occurs today. These new approaches will occur to some extent by those concerns with context that are now beginning to impact the analysis stage of design.

These context considerations have been generated by the conceptual influence of both performance technology and the total quality management (TQM) movements. Essentially, both movements are concerned with the corporate "bottom line" and satisfying the requirements of the customer, and such emphases negate traditional assessment and evaluation procedures which are limited to examining short-term learner outcomes. Instead, they stress what Kirkpatrick (1983) has previously labeled as Level 3 and 4 evaluations. Here assessments are made of the application of knowledge and skills and upon subsequent organizational impact, rather than learner reactions to instruction and knowledge acquisition. Level 3 and Level 4 summative evaluations are likely to be demanded, especially in the workplace, but it is not unlikely that school environments will also require such data. Moreover, it is being suggested that designers also use Level 3 and Level 4 techniques when conducting formative evaluations as well as summative (Dick and King, in press).

The concerns with retention and transfer of training also are evident in the addition of confirmative evaluation processes to a typical ISD model as has been suggested by Hellebrandt and Russell (1993). The object of this endeavor is to determine the continuing competence of learners or the continuing effectiveness of instructional materials. Not unrelated to Level 3 evaluation, confirmative evaluation complements the thrusts of

situated cognition and anchored learning which address the importance of embedding learning activities in realistic contexts as a means of promoting transfer of training (Streibel, 1991).

Micro-Design Models of the Year 2000

In addition to those enhancements of the typical macro-design model, micro-models which guide the selection and sequencing of instructional strategies are also likely to change in the twenty-first century. Two key micro-model issues which have been stimulated by emerging theoretical developments will be discussed here -- the nature of learner control, and the transfer of training.

The Nature of Learner Control in Design Models of the Future. At the heart of constructivism is the issue of learner control. The true constructivist believes that meaning and reality are functions of individual interpretation (Jonassen, 1991; Lebow, 1993). An extension of this orientation to instructional design then implies that:

> instructional goals and objectives would be negotiated rather than imposed upon the learner;
> sequences of learning activities would be flexible rather than prescribed;
> learning strategies would not be dictated by the design; and
> evaluation would be less criterion-referenced (Jonassen, 1991).

Aspects of this orientation are not entirely unrelated to the conclusions of both cognitive-based designers (Wilson and Cole, 1991), as well as to some who have struggled to develop instruction using the full capabilities of the new technologies. For example, Hannafin (1992) speaks of the possibilities the interactive technologies offer for student-centered learning. In these situations, the designs "focused on supporting student-initiated lesson navigation, providing an organizing theme or context for lesson activities, and embedding aids and support in the form of help, elaboration, and other resources that can be selected by the student to improve understanding" (Hannafin, 1992, p. 54).

Such environments are far less structured than is typical of those designed using systematic procedures on both a macro- and micro-level. While this is compatible with the newer technology-based instruction, such as a hypertext lesson, it is not nearly so compatible with environments demanding accountability. For example, the TQM movement is predicated upon organizational objectives (i.e. a vision or mission statement), policies, and procedures that specify the manner in which the objectives will be achieved (Caplan, 1993). Likewise, performance technology relies upon a high degree of structure to meet, evaluate, and report the impact of instruction upon the solution of organizational problems. Such orientations are not alien to many instructional designers who adhere to traditional systems thinking (Dick, 1993b), but they do not seem to facilitate the types of learning environments proposed by Hannafin, Jonassen, or Lebow.

This philosophical dichotomy transcends other aspects of micro-design. Another key example is that of message design. Berry (in press) describes the radical shifts in future message design, stimulated by learner centered design and situated cognition, in which instructional environments will facilitate learners as they explore areas of knowledge and develop their own versions of that knowledge. "The development of such systems is predicated on a shift from design of 'stimulus messages' to interface design" (Berry, in press, p. 8). This is a radical departure for traditional message design, and the dimensions of such change are compounded by the implications of the new technologies, technologies that not only provide for nearly full fidelity and a wider array of formats, but also for the design of message environments and experiences.

Transfer of Training Strategies in Design Models of the Future. Transfer of training is critical in most education and training environments, and to many, serves as a criterion

for effective instruction. Consequently, it serves as a logical focus of analyses of strategy selection and sequencing. Current transfer discussions have emerged to a great extent from an examination of situated learning and its applications in instructional design. The issue centers on the relative effectiveness of using either situated, authentic tasks or generalized principles in instruction as a means of promoting transfer. Winn (1993) argues that traditional instructional design (ID) and situated learning (SL) are compatible if compromises are made:

> For ID this means primarily re-integrating design with instructional delivery so that the interaction between student and instruction becomes more adaptive to situations that vary from one problem to the next. It also means the development of learning environments in which students construct knowledge for themselves. For their part, proponents of SL need to develop effective ways for bringing authentic activity into the classroom, or for better articulating school-based and community-based activity (p. 20).

These compromises highlight the instructional strategy changes that are suggested by situated learning, changes which alter the common use of generic prescriptions. While these changes are not inconsistent with the recommendations which have been made in other quarters with respect to learner control, they are not uniformly accepted. Tripp (1993), for example, continues to question the ability of "situated" instructional activities to promote transfer. For example, while supporting the importance of showing the relevance of content, he cites the barriers created for many learners by the complexities of the "real world" when they are introduced into instruction.

Other lines of current thinking also provide direction for promoting transfer. The emphasis upon contextual variables in constructivism and performance technology also speaks to transfer of training. Richey and Tessmer's (in press) contextual analysis model speaks to environmental cues and incentives which impact transfer, as well as opportunities for content use and application in diverse settings. Such data suggests modifications in both learning activities and supporting instructional management systems.

Summary

The stimulation currently provided by the rich intellectual activity in the realm of instructional design is creating the likelihood of change, not only in the generic procedural models traditionally used to guide ISD projects, but also in the types of the strategies used to achieve learning goals. Some of these changes are obvious now; others will become more common as we approach the new century. As the design generations evolve, it is possible that the high degree of procedural unanimity the field has previously enjoyed may be replaced by more diversity. For example, there may be macro-design models which do not advocate the specification of goals and objectives. There may be micro-design models which do not advocate sequencing using the traditional hierarchical approach based upon Gagne's Cumulative Learning Theory. This diversity, while admittedly unsettling to many of us, is also exciting, and offers a promise of not only new models, but new challenges to practitioners and researchers alike.

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